Electronic properties for the superheavy elements 111 to 119 from relativistic ab-initio calculations

P. Schwerdtfeger[1], M. Seth[1]

[1] The University of Auckland, New Zealand

p.schwerdtfeger@auckland.ac.nz

Relativistic effects scale approximately with Z^2 (Z=nuclear charge), hence very large relativistic effects are expected for the trans-actinides, the elements beyond nuclear charge 103, the so-called superheavy elements. The heaviest element discovered so far is the superheavy element 116 with a half-life of about 33 ms for the isotope 289[1]. For chemical studies at an atom-at-a-time scale half-lives within at least the second range are required. The recent discoveries of superheavy isotopes in the second-range of stability open the way for atom-at-a-time chemistry of 108 (Hs), 110, 112 or even 114 [2]. A major drawback in the synthesis is the small production cross-section which drops rapidly with increasing nuclear charge. Thus, for the prediction of periodic trends and the chemical behaviour for elements including the 7th period of the periodic table and beyond, the use of theoretical methods are currently the only way to gain useful chemical information. This talk gives an overview on properties for the elements with nuclear charge 111 (eka-Au) to 119 (eka Fr) [3]. It is shown that relativistic effects significantly influence chemical properties of these elements (see figure below). In contrast, quantum electrodynamic effects are small and can be neglected for chemical properties. We also address the current problem of identifying new isotopes and suggest K-inversion spectroscopy as a useful tool [4].

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